9-12 Sea Turtle Dives Activity

South Carolina Aquarium

Overview

Focus Question
How do scientists use dive data to determine the habits of sea turtles?

Activity Synopsis
Students will discover the science and technology used to research sea turtles by analyzing dive profiles.

Time Frame
30 minutes

Objectives
The learner will be able to:

- Identify technology used to research sea turtles
- Analyze scientific data from sea turtle dives
- Explain the roles that sea turtles have in marine ecosystems

Student Key Terms

- Community
- Ecosystem
- Endangered species
- Food chain
- Foraging
- Predator
- Prey
- Reptile
- Satellite tag
- Sea turtle
- Threatened species

Teacher Key Terms

- Carapace
- Cold-blooded
- Dredging
- Keystone species
- Plastron
- Poachers

Standards

South Carolina College- and Career-Ready Science Standards 2021
Biology: B-LS2-2, B-LS2-7

*** Bold standards are the main standards addressed in this activity**

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2014 Academic Standards and Performance Indicators for Science

Biology: H.B.1A.1, **H.B.1A.4**, **H.B.1A.6**, H.B.1A.8, H.B.6C.1, **H.B.6D.1**

*** Bold standards are the main standards addressed in this activity**

South Carolina College- and Career-Ready Science Standards 2021

Biology Performance Expectations

B-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
B-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

2014 Academic Standards and Performance Indicators for Science

Biology Performance Indicators

H.B.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims
H.B.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.
H.B.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
H.B.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.
H.B.6C.1 Construct scientific arguments to support claims that the changes in the biotic and abiotic components of various ecosystems over time affect the ability of an ecosystem to maintain homeostasis.
H.B.6D.1 Design solutions to reduce the impact of human activity on the biodiversity of an ecosystem.

Cross Curricular Standards

South Carolina College and Career Standards for ELA
Inquiry (I) – 2.1
Communication (C) – 1.1, 1.4

Background

Key Points
Key Points will give you the main information you should know to teach the activity.

- There are seven different species of **sea turtles** in the world, but only four can be found along the coast of South Carolina.
- All species of sea turtles do not eat the same type of prey. Different species of sea turtles have different adaptations for eating certain prey items.
- Scientists study sea turtles using satellite tag data.

- All adult sea turtles are top **predators** in marine **food chains** and they help control population growth in their **prey** items.
- Sea turtles are an integral part of the ocean's food chains and they need to be protected around the world in order to save their populations.
- Sea turtles often mistake marine debris as prey items, and this can be detrimental to their health and potentially fatal.
- All sea turtles are listed as either threatened or endangered by the Endangered Species Act.

Detailed Information

Detailed Information gives more in-depth background to increase your knowledge, in case you want to expand the activity or you are asked detailed questions by students.

Sea Turtles are **reptiles**. They have a top shell called the **carapace** and a bottom shell called the **plastron**. Sea turtles have a shell for protection, but they cannot pull their limbs inside. Along with their shell, their large size helps protect them from most **predators** once they are adults. The front legs are flippers shaped and help to propel the turtle in the water. The back legs are used mainly as rudders for steering.

Like all reptiles, sea turtles are air breathers, lay leathery shelled eggs, have scaly skin and are **cold-blooded**. They can be found throughout the world and are listed as a **threatened** or **endangered species** internationally.

There are 7 species of sea turtles in the world. The 7 species are Flatback, Green, Hawksbill, Kemp's Ridley, Leatherback, Loggerhead and Olive Ridley sea turtles (link to species id and http://www.cccturtle.org/seaturtleinformation.php?page=species_world .) US Atlantic Ocean sea turtles species live their entire lives in the ocean except when they are developing in the egg and when females come on shore to lay their eggs.

Foraging Adaptations

Sea turtle species do not eat the same diet. Hawksbill, Green, and Leatherback sea turtles have very distinct diets. Loggerheads, Kemp's Ridley, and Olive Ridleys have similar diets. The shape of a sea turtle's beak can provide insight to the type of **prey** that it primarily eats. The beak shape is an adaptation of sea turtles that allows them to target certain types of prey.

Loggerhead, Kemp's Ridley and Olive Ridley sea turtles have beaks that allow them to crush through shelled-mollusks and crabs. Loggerhead sea turtles have a very large and very strong beak. Inside of the beaks are bony plates for crushing the hard shells of their prey. Although shelled mollusks and crabs make up most of their diet, loggerheads sometimes eat jellies, marine invertebrates, cuttlefish, seaweeds, and sponges. Kemp's Ridley sea turtles have also been known to eat fish and jellies. The diet of Olive Ridley sea turtles consists of fish, shrimp, crabs, urchins, tunicates, jellies, and seaweeds.

Hawksbill sea turtles have a beak much like a bird's – hence their name. This type of beak gives hawksbills the ability to slice into sponges and cut pieces off. It also allows them to get in crevices of coral reefs. Hawksbills feed primarily on sponges growing on coral reefs. A small portion of their diet can consist of marine invertebrates, seaweeds, hydrozoans, and cuttlefish.

Green sea turtles have an upper jaw that is serrated. This beak shape allows them to scrape algae off of hard substrate and it also allows them to shear sea grasses, seaweeds and algae. The diet of a green sea turtle is mostly algae and seaweeds.

Leatherback sea turtles are the largest sea turtles and astonishingly their diet mostly consists of jellies. Leatherback sea turtles have softer beaks than the other species of sea turtles; however, their beaks have sharp points. The cusps on a leatherback's beak can easily pierce the soft body of a jelly. Leatherbacks also have fleshy spines in their mouths that help leatherbacks keep the jelly in their mouths once they've captured it with their beaks. This species of sea turtle eats primarily jellies and other soft-bodied organisms such as hydrozoans.

Researching Sea Turtles

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Scientists can track sea turtles using devices such as **satellite tags** and time depth recorders (TDR). A satellite tag allows scientists to track the location of sea turtles. Satellite tags are also used on many different animals around the world. First, a tag must be placed on an animal and then it can be tracked. For sea turtles, the tag looks like a small box with an antenna coming out of it. The tag is glued to a sea turtle's shell and then the sea turtle is released back into the ocean. Every time the sea turtle surfaces, the tag sends out a signal to a satellite in the sky and the satellite sends the information to the scientists. The satellite tag collects information on the turtle's location, the temperature of the water, how deep the turtle dives, how long the turtle stays underwater, etc.

Because scientists can track the location of sea turtles, they can observe firsthand what it forages on in the wild. Sometimes these observations can be made without satellite tags. For instance, if scientists can identify foraging spots, then no satellite tags are needed. A time depth recorder is a device that can be placed on a sea turtle and it records the depth of the dive, the duration of the dive, and the time spent at the surface. This type of technology is advancing and now scientists can even put small video recorders on sea turtles. This allows them to see exactly what a sea turtle is preying upon!

Analyzing diving data can help scientists determine what a sea turtle is eating. Scientists can put the data into a graph and look at a dive profile to determine when a sea turtle is foraging and when it is resting. They can also look at dive depths to get an idea of what types of prey a sea turtle might be trying to eat. For instance, scientists believe that leatherbacks make very deep dives during the day to eat jellies that migrate deeper in the water column during daylight.

On this dive profile, the x-axis gives the hours of the day in a 24-hour period. The y-axis represents the depth of the ocean in meters. The lines represent the movement of one sea turtle. The downward points (highlighted by the box) show the deepest depth the sea turtle dove on one dive. The section highlighted in the oval shows a period of time when the sea turtle was mostly like resting instead of foraging for food since it was not making back to back deeper dives. It's important to note the activity of the turtle at different times of the day. Did the turtle start making deeper dives at dusk or dawn? This can help determine the type of prey the sea turtle was hunting. It is also important to know what ocean floor features are present underneath the water. Are there coral reefs, sea grass beds, etc?

Sea Turtles in Marine Food Chains

All species of sea turtles play a vital role in marine **ecosystems**. As adults, they are usually at the top of marine **food chains** and food webs and they are considered keystone species. They help to maintain populations and prevent an over-abundance of their prey items. For instance, leatherbacks play a role in controlling large populations of jellies. If jelly populations get out of control, then they will eat a large number of juvenile fish causing impacts on commercial fishing.

Scientists are discovering that the grazing of green sea turtles on sea grasses can positively affect the growth of sea grasses. The sea turtles cause a good disturbance of the sea grass beds and that promotes growth and discourages aggressive species of sea grasses from taking over beds. Scientists are also seeing this same effect with hawksbills and sponges.

Marine Debris

Sea turtles will often mistake marine debris for prey items. For instance, a plastic bag floating in the water looks very similar to a jelly. Sea turtles have small brains in comparison to their large bodies. A loggerhead sea turtle can weigh 200-400 lbs when full grown, yet it has the brain the size of a grape. It doesn't mean that they are dumb; they are just instinct-driven. If something looks like a prey item, then their instincts tell them to eat it because it should be a prey item! More and more plastic and other type of marine debris enter the ocean everyday. Sea turtles are continually at danger of mistakenly eating this litter. In some instances, marine debris can pass through a sea turtle's digestive tract, but it can also cause serious damage. Eating foreign objects can block the digestive tract of sea turtles and this causes the sea turtle to feel full. If it feels full, then it is not going to hunt for food. Eventually, the sea turtle will end up starving to death. Some types of marine debris can be toxic and poison the sea turtle when ingested. Eating litter could also cause a sea turtle to choke. It is common in our Sea Turtle Hospital to admit turtles that have eating various types of marine debris.

Conservation

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Sea turtles have been in existence for 65-145 million years according to fossil records. Today, they face many natural and human induced threats throughout their life. This is a breakdown of some of those threats:

Eggs:

- Natural threats to eggs include predators (fire ants, raccoons, domestic cats and dogs and ghost crabs), vegetation (roots smother eggs) and storms (high tides washing over nests).
- Human threats to eggs include **poachers**, vandalism, beach nourishment and **dredging**.

Hatchlings:

- Natural threats to hatchlings include predators (ghost crabs, raccoons, fire ants, birds and fish), disease and weather.
- Human threats to hatchlings on the beach include poachers, beach obstacles (sand castles, holes and beach litter) and beach front lights (can confuse hatchlings to go in opposite direction of the ocean)
- Human threats to hatchlings in the sea include fishing gear, litter and boats.

Juveniles:

- Natural threats to juveniles include predators such as large fish and diseases such as Fibropapillomatosis (skin tumors), internal parasites (heavy loads of flatworms), external parasites (heavy loads of leeches, barnacles, worms or algae).
- Human threats to juveniles include litter, boats and fishing gear (fishing line, ropes, nets and crab traps).

Adults:

- Natural threats to adults include predators such as shark and diseases such as Fibropapillomatosis (skin tumors), internal parasites (heavy loads of flatworms) and external parasites (heavy loads of leeches, barnacles, worms or algae).
- Human threats to adults include litter, boats and fishing gear.

Some people may wonder why it is so important to protect sea turtles. Sea turtles, just like all living things have their place in the ocean ecosystem. Without a balance of animal populations through food chains, communities and ecosystems could become unbalanced. People around the world rely on the ocean for food, oxygen, the earth's climate and medicines.

About 16% of the world's food comes from the ocean. This might not seem like a large percentage, but it equals about 200 billion pounds each year. It is thought that about 90% of the world's oxygen is produced by the phytoplankton of the ocean. This is important because all living things need oxygen to breath. The ocean also plays a huge role in the climate of the earth. The ocean collects and mixes carbon dioxide, heat and water which in turn will control the climate patterns around the world. Researchers are always discovering more about the living things in the ocean. New discoveries could lead to medical breakthroughs in cures for diseases and medicines.

Sea turtles are known as keystone species, a species that if removed could cause dramatic changes to the **community**. An example of this is the leatherback sea turtle and jellyfish keystone species interaction. Fishermen have noticed an increase in jellyfish populations in the Atlantic Ocean. Jellyfish feed on fish larva. With more jellies there is less fish growing to adult size and therefore less fish for fisherman to catch. The reason is most likely because of the dramatic decrease in the leatherback sea turtle populations. Leatherback sea turtles eat jellies and without them the jelly populations are increasing. The main cause of the decrease in leatherback sea turtle population is from being caught in fishing nets. It's a cycle that went on for so long that without drastic changes could mean an end to many fishing industries.

Many efforts are being done to protect sea turtles around the world. Protecting sea turtles must include the protection of the

beaches as well as the ocean. Sea turtles are federally protected by the Endangered Species Act.

The following list of some things that can be done to protect sea turtles:

1. Never touch a sea turtle if you see one in the wild (this is illegal).
2. Call your local Department of Natural Resources (DNR) if you find an injured or stranded sea turtle
    - South Carolina DNR – (800) 922-5431
3. Turn off beach front lights during nesting season (May-Oct.)
4. Fill in sand holes on the beach during nesting season
5. Knock down sand castles at the end of the day during nesting season
6. Don't let your dog dig in the sand dunes (this is illegal)
7. Don't walk on sand dunes (this is illegal)
8. Use canvas bags instead of plastic to reduce trash
9. Don't litter
10. Use caution when boating and always watch out for turtles
11. If you catch a turtle while fishing, call DNR
12. Fisherman must use Turtle Excluder Devices (TED's) on all fishing/shrimping nets so turtles can get out if caught (this is law in the US)
13. Join an Island Turtle Team
14. Support a Conservation Organization (Like the South Carolina Aquarium)
15. Leave No Trace (be respectful of nature while you are enjoying it)

Procedure

Materials

- Sea Turtle Dives Intro
- Dive Profiles (one per group)
- Sea Turtle Dives Data Sheet (one per group)
- Sea Turtle Dives Data Sheet Answer Key (Teacher only)
- Pencils

Procedure

1. Introduce the students to the concept of studying sea turtles using satellite tag data. Use the Sea Turtle Dives Intro PowerPoint to explain how dive profiles can be used to identify the habits of a sea turtles such as what they eat. This information can be used in order to better protect them.

2. Give each student group (2-3 students) a set of Dive Profiles and a Sea Turtle Dives Data Sheet to complete. You may need to leave the dive profile slide from the intro PowerPoint up for the students to reference (last slide).

3. Go over the answers with the students asking them questions along the way such as:

- Do you think looking at diving profiles is the best way to figure out what a turtle is eating?
- Does it give you an accurate account of what a sea turtle is eating?
- What are some positives and negatives of this method?
- Ask the students to think of different methods that would be more accurate.

4. Talk with them about how studying sea turtles can be challenging because they live in the ocean, but by using dive profiles we can try to understand them better and therefore protect their habitats and food sources.

Follow-up Questions

- What devise/tool would you design to study sea turtles?

Assessment

Have students to complete the Sea Turtle Dives Assessment. Assessment will ask students to analyze a sea turtle dive profile as well as come up with a design for how they would study sea turtles.

Scoring rubric out of 100 points

Sea Turtle Dives Assessment Answer Key
Each question is worth 10 points. 10 questions totally 100 points.

Cross-Curricular Extensions

STEM Extension
Turtles sometimes arrive at rehabilitation centers with “bubble butt” (when their back side floats), which prevents them from diving to get to their food. Hospital personnel attach weights to the turtles to enable them to get to the bottom for food. They use Velcro so that they can change the size of the weights. Have students use a plastic water bottle with a lid as the turtle and then using Velcro tape on the bottle and the weights, see how many grams it takes to make the turtle "bottle" just barely sink to the bottom. Don't over weight the bottle because this would represent too much weight on the turtle making it difficult for it to surface and breath. Do this with several different sized bottle. Make a graph showing the relationship between the volume of the bottle and the mass needed to make it just sink.

STEAM Extension
Does a sea turtle’s carapace shape determine its ability to dive in the ocean? Students can fashion different shapes of the sea turtles body without legs out of aluminum foil. Using a large fish tank (or clear container of water) all of the turtle designs can be dropped at the same time on the surface. Students can time how long it takes for each design to hit the bottom of the tank (calculate speed) and create graphs to show results.

This same activity can be created with sheets of metal and solder. Students can build the sea turtle and learn how to solder (fun and easy to master). This is a great use of leftover floppy discs from computers. The 3 x 5 disc have some great round metal pieces that solder will stick to easily. Advanced students might even want to add legs and a tail to their turtle with left over pieces of wire soldered to their carapace.

Resources

Teacher and Student Reference Books

Bolten, Alan B. and Blair E. Witherington. Loggerhead Sea Turtles. Smithsonian Institution, Washington, D.C., 2003.

Gulko, David and Karen Eckert. Sea Turtles: An Ecological Guide. Mutual Publishing, Hawaii, 2004.

Lutz, Peter L and John A. Musick. The Biology of Sea Turtles. CRC Press, Boca Raton, 1997.

Lutz, Peter L., John A. Musick and Jeanette Wyneken. The Biology of Sea Turtles, Volume II. CRC Press, Boca Raton, 2003.

Ruckdeschel, Carol and C. Robert Shoop. Sea Turtles of the Atlantic and Gulf Coasts of the United States. The University of Georgia Press, Georgia, 2006.

Safina, Carl. Voyage of the Turtles: In pursuit of the Earth's Last Dinosaur. Henery Holt and Company, 2007

Spotila, James R. Sea Turtles: A Complete Guide to Their Biology, Behavior and Conservation. Johns Hopkins University Press, 2004.

Witherington, Blair. Sea Turtles: An Extraordinary Natural history of Some Uncommon Turtles. Voyager Press, St. Paul, 2006.

Teacher and Student Reference Websites

Caribbean Conservation Corporation
http://www.cccturtle.org/seaturtleinformation.php
This site has many links to sea turtle information. You will be able to link to basic sea turtle biology about life history, species information, nesting and behavior as well as learn why sea turtles are important.

Defenders of Wildlife
http://www.defenders.org/wildlife_and_habitat/wildlife/sea_turtles.php#
Good Site for information on sea turtle status on the Endanger Species List.

Marine Bio
http://marinebio.org/Oceans/Ocean-Resources.asp
Good site for understanding ocean resources.

National Oceanic and Atmospheric Association (NOAA)
http://www.nmfs.noaa.gov/pr/species/turtles/
This site is a great resource for basic sea turtles information, but has many links to more in depth information as well. You will be able to click on links to each sea turtles species and get details information as well as click to other resource websites.

http://graysreef.noaa.gov/tw/turtles.html
Life history and basic information of the five sea turtle species found on the east and gulf coasts of the United States.

Sea Turtle.org
http://www.seaturtle.org
This website has all sorts of information to look through and updates the records daily (nesting numbers, stranding numbers,…). It also gives you the needed information to report sick or dead sea turtles found as well as satellite tracking maps.

http://www.seaturtle.org/documents/ID_sheet.pdf
Species dichotomous key pdf. Download this resource and it will show you how to identify each sea turtles species.

South Carolina Department of Resources (SCDNR)
http://www.dnr.sc.gov/seaturtle/outreach.htm
Good site for resources (curricula, field trip sites, links to other sea turtle sites and list of resource books).

http://www.dnr.sc.gov/marine/pub/seascience/pdf/seaturtle.pdf
Sea turtle life history and general facts as well as threats and conservation tips designed as a easy to print, pdf.

US Fish and Wildlife Service (USFWS)
http://www.fws.gov/northflorida/SeaTurtles/turtle-facts-index.htm
Information on each sea turtles species.

http://www.fws.gov/northflorida/SeaTurtles/20090700_You_Can_Help_ST.pdf
Link to brochure on ways people can help protect sea turtles. Brochure can be printed and folded as tri-fold or you can contact the USFWS to send you some.

Online Curricula

SEA K-12 Lesson Plans
http://www.sea.edu/academics/k12.aspx

NOAA's Aquarius Lesson Plans
http://www.uncw.edu/aquarius/education/lessons.html

NOAA's Learning Ocean Science through Ocean Exploration Curriculum
http://oceanexplorer.noaa.gov/edu/curriculum/welcome.html#curriculum

Project Oceanica Lessons
http://oceanica.cofc.edu/LoggerheadLessons/LoggerheadHome.htm

Project WILD
http://www.projectwild.org/resources.htm

Videos

Wildlife Survivors: A Tale of Two Turtles/Dolphins in Danger
National Geographic – Tales from the Wild: Cara the Sea Turtle
Nature – Voyage of the Lonely Turtles
The Sea Turtle: Threatened Vagabond of the Indian Ocean

Journey of the Loggerhead
http://www.envmedia.com/production/loggerhead/index.htm

Last Journey for the Leatherback
http://vimeo.com/7782397

The Turtle Ladies of Charleston County
http://www.scetv.org/index.php/carolina_stories/show/the_turtle_ladies_of_charleston_county/